

ZOOLOGY.—*The systematics, affinities, and hosts of the one-tentacled, commensal hydroid Monobrachium, with new distributional records.* CADET HAND, University of California. (Communicated by F. M. Bayer.)

(Received December 21, 1956)

The hydroid *Monobrachium parasitum* was first described by Mereschkowsky (1877) from the White Sea. Subsequently Leche (1878) reported it from Nova Zembla in the Kara Sea, Wagner (1890) from the Bay of Solowetzka near the isles of Baby-Loudy and Nowny-Loudy in the White Sea, Levinsen (1893) from Umanak, Egedesminde, and Frederikshaab along the west coast of Greenland, and Bonnevie (1899) from near Spitsbergen. All these localities are within the boundaries of the Arctic Ocean. It was not until Stafford (1912) discovered *Monobrachium* in the Gaspé region of Canada that its distribution was extended to the Atlantic and to lower latitudes. Fraser (1918) further extended the known range of this species when he described it from Nanoose Bay, British Columbia, on the Pacific coast of Canada. Fraser's report is the last new record of *Monobrachium* to the present date, and the known distribution would include the Arctic, Atlantic, and Pacific stations reported above. In view of the presumed circumboreal distribution of *Monobrachium*, and the fact that it has never been reported south of lat. 48° N. in either the Atlantic or Pacific, it was with some surprise that I discovered *Monobrachium parasitum* to be abundant in relatively shallow water off the west coast of California and Baja California in the area from about lat. 34° to 32° N.

Mereschkowsky gives no precise Latin or Greek stem for the specific name *parasitum* which he chooses for this species, and it is interesting that certain authors [Leche (1878), Wagner (1890), Bonnevie (1899)] have used the name *parasiticum* for this animal. If we assume that Mereschkowsky derived his specific name from the Latin noun for "a parasite" it would appear that he has treated this noun as an adjective and caused it to agree grammatically with the generic name, a procedure at variance with the modern Rules, which state that nouns

must be appositional, nominative, or possessive genitive. It may have been because of the agreement of the genders of the two names that the authors cited above chose to use the adjectival specific name *parasiticum*. No matter what Mereschkowsky's intention in this matter was, there seems to be no way in which we can change the orthography of the name at this date. We must accept Mereschkowsky's name as an abbreviated adjectival stem which he chose in preference to the full stem of the original Latin adjective. Therefore, I shall use Mereschkowsky's name *M. parasitum* for this species.

This hydroid has been reported only as living upon the shells of bivalves and always near the posterior end of the shells or surrounding the siphons. Mereschkowsky found it upon *Tellina solidula*, although Leche (1878) had specimens of both *T. solidula* and *T. lata* but found it only on *T. lata*. Leche comments that Mereschkowsky's drawing of *T. solidula* looks more like *T. lata* than *T. solidula*. Wagner (1890) describes the mollusk host only as a *Tellina*, but he cites in his introduction the occurrence of *Monobrachium* on *Tellina calcarea*. In a footnote to that citation he refers to the work of Leche (1878) who does not mention *T. calcarea*. Perhaps *Tellina calcarea* of Leche is *Macoma calcarea*. Levinsen (1893) found *Monobrachium* on *Macoma calcarea* and *Tellina moesta*, while Bonnevie (1899) does not identify the host clam. The Atlantic examples of *Monobrachium* found by Stafford (1912) occurred on *Tellina tenera* and the Pacific material of Fraser (1918) on *Axinopsis sericatus*. Most of the above bivalves are small species, seldom exceeding 4 cm in greatest dimension, while others such as *Axinopsis* are minute and are little more than 2 mm in diameter. The material from California occurs on several different species of bivalves. These include a 2 mm long immature *Tellina* sp., *Axinopsis viridis* and *Aligena redondoensis*.

These mollusks were kindly identified for me by Dr. Myra Keen of Stanford University. The latter two species above are minute species and seldom exceed a few millimeters in diameter. One notes here that the Atlantic and Arctic hosts of *Monobrachium* are clams of considerably greater size than those from the Pacific. Also, it seems worthy of mention that with the exception of *Macoma calcarca*, all the clam hosts have very short siphons, or none at all, and live at the surface of the ocean's bottom. This habit of the clam hosts must be a prerequisite for *Monobrachium*, since if these hosts were to burrow much below the surface it seems unlikely that the hydroid could survive. Unfortunately, there are no adequate descriptions of the hydroid as a living animal, although Fraser (1918) notes the similarity of the posturing of *Monobrachium* to that described by Gosse (1857) for *Proboscidactyla* (= *Lar*).

The material upon which the present report is based came into my hands from several sources. The first five specimens were collected by William Walton, of the Scripps Institution of Oceanography, from depths of 40 to 65 fathoms in Todos Santos Bay, Baja California, November 1952 and March and April 1953. Mr. Walton also gave me a sixth specimen which he collected on August 20, 1952, in Todos Santos Bay. This specimen, taken at a depth of 165 fathoms, is unique not only in the great depth at which it was found but also in that it was living upon the test of the arenaceous foraminiferan *Haplophragmoides planissimum*. This is the first indication that *Monobrachium* will accept any others than bivalves as a host substrate.

Six specimens of *Monobrachium* were received from Dr. Olga Hartman, of the Allan Hancock Foundation of the University of Southern California. These specimens were taken at 42 fathoms in Santa Monica Bay, Calif.

The remaining material consisted of 72 specimens which were collected in June, October, and November 1953 in depths of from 30 to 120 fathoms by Robert Bieri, of the Scripps Institution of Oceanography. This material was obtained from positions southwest and west of Point Loma, San

Diego, Calif., and within approximately one mile of the Point. The bottom varied at these stations from a fine sand to soft, silty deposits.

The hydroid *Monobrachium parasitum* has been well described by its original finder, and Wagner (1890) has given a very complete description of both the hydroid and medusa. Bonnevie (1899) added to Wagner's description and Fraser (1918) redescribed this species. The material I have observed seems to differ in no significant way from what has been described previously and little is to be gained by a redescription. However, certain features of the material I have examined do not agree precisely with what has been previously recorded and these will be mentioned, along with some new observations.

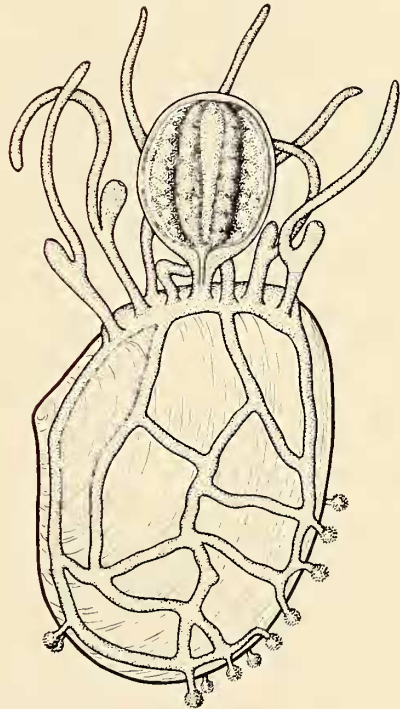


FIG. 1.—A colony of *Monobrachium parasitum* with one adult female medusa.

I have already commented on the fact that the bivalve hosts of the Pacific representatives of *Monobrachium* are smaller than those in the Arctic and Atlantic Oceans. This condition may result merely from an absence in the Pacific fauna of clams of

several centimeters' length of suitable habits and habitats, or could reflect genetic differences in the Pacific hydroid. It is possible that the Pacific *Monobrachium* is another species, but I have little evidence to favor this view. As a result of the smaller hosts, however, the appearance of the colonies which I have observed is slightly different from that of those figured from the Arctic. The accompanying Fig. 1 illustrates a small colony of *Monobrachium* from Santa Monica Bay and shows how the hydrorhizal network wanders over the whole shell surface to the very margin where the curious knobbed defensive zooids stand. If one compares this with the descriptions and figures of Mereschkowsky, Wagner, and Bonnevie one notes that in their material the colony, including all of the hydrorhizal net and defensive zooids, seldom covered more than the posterior one-third of the host shell.

Another minor difference between Pacific and other representatives of *Monobrachium* concerns the size of the polyps. In the material I have examined it has been very seldom that a polyp 1 mm long has been present. Fraser (1918) gave the polyp size as 0.7 to 0.8 mm in height. Arctic polyps are reported up to 2 mm long with the single tentacle as long as 5 mm. However, knowing from observations of other naked hydroids the extreme changes in size of which they are capable, it seems unlikely that the smaller size of the Pacific material has any very great significance.

Some interesting and important observations have been made on the medusae found attached to various colonies. In general, the medusae are not more than 2 mm in greatest dimension and only rarely have I found more than one large medusa on a colony. Perhaps for this reason I have not been able to confirm Bonnevie's observation that medusae of both sexes occur in a single colony. The wide and thick radial canals, the paired gonads along the canals, the nearly solid ring canal and the light covering of perisarc over the medusae all agree with previous descriptions. Also the delicate velum, the very short, closed manubrium and the 16 small hollow tentacles agree with earlier observations. However, between the second and third order of tentacles in each quadrant there occurs a single, external, closed, endodermal

statocyst which has been all but overlooked by previous authors (see Fig. 2). It was only Wagner (1890) who seems to have seen these structures at all, and he describes them as masses of cells which he took to be rudiments of marginal sensitive bodies. He goes on to say that such sensitive bodies are wanting in the medusae of *Monobrachium*. I have found in sections of 3 medusae and in several examined under the pressure of a cover slip that the statocysts are readily demonstrable and are clearly closed and endodermal. The three medusae sectioned were to all appearance adult, and the eggs of the two females showed large germinal vesicles and looked as if the eggs were ready to be shed. There is no indication in the material I have examined that these medusae are released, and one attached medusa I observed had shed all but a few of its eggs. This, however, is not positive evidence that the medusae may not be released before spawning, since it is quite possible that the eggs could have been squeezed out of the medusa by other material in the dredge or when the haul was sorted.

Mereschkowsky (1877) figured a nematocyst of *Monobrachium* which is clearly a microbasic eurytele. I have examined both the hydroid and medusoid stage and can find but one type of nematocyst, a microbasic eurytele from 7 to 11 μ in diameter by 9 to 16 μ in length. There is no difference in size

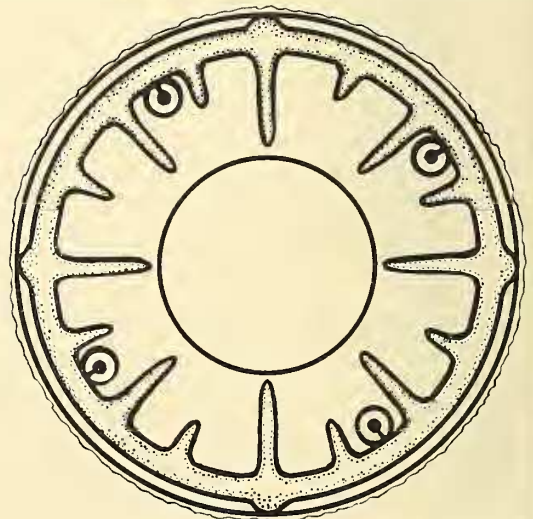


FIG. 2.—Diagram of the arrangement of tentacles and statocysts of an adult medusa of *Monobrachium parasitum*.

ranges between the nematocysts of the hydroid and its medusa.

The systematic position of *Monobrachium* has not to date been clearly established. *Mereschkowsky* (1877) believed it a member of the Athecata and on the basis of its single tentacle he established a new family, *Monobrachiidae*, for it. Mereschkowsky was impressed with the many analogies of his animal to "Lar", but felt that the two were quite separate. It seems curious that Mereschkowsky did not give more weight to his own observation that the gonads were developing beneath the radial canals, which should have suggested to him, as it did later to Bonnevie (1899), that *Monobrachium* was a leptomedusan. Levinsen (1893) listed *Monobrachium* in the Laridae (now the Proboscidaetlylidae) without comment. Bonnevie (1899), after considering the evidence available to her, felt that this hydroid was on the borderline between the thecate and athecate hydroids. Fraser (1918) made a point of the differences in number of radial canals between the genera *Lar* and *Monobrachium*, but commented that if the gonads of *Lar* were placed in a position similar to those of *Monobrachium*, the two genera should be placed in the same family. Fraser seems not to have been aware of the work of Browne (1896), who demonstrated that *Lar* was the hydroid stage of *Proboscidaetyla* (= *Willia*) and that the medusae of the two genera in question have very different gonadal patterns. Fraser (1937, 1944) listed *Monobrachium* in its own family, the Monobrachiidae, and he continued this classification in 1946. Hand and Hendrickson (1950) considered *Monobrachium* to be a member of the family Proboscidaetlylidae.

As mentioned earlier, *Monobrachium* possesses closed endodermal statocysts and has a mononidom of microbasic euryteles. Also, the endoderm of the tentacles of the hydroid is in direct continuity with that of the gastric cavity, and the tentacles of the medusa are hollow. These characters, taken in their totality, can only be indicative of one group of Hydrozoa, the Limnomedusae. Among the Limnomedusae only a single family, the Olindiidae, has endodermal statocysts; we face the question of whether or not to place *Monobrachium* in this family.

There seems to be no question that both hydroid *Monobrachium* and medusa of *Monobrachium* are highly specialized. The hydroid, as a commensal, presumably "fishes" in the incurrent stream of the bivalve host, and the one tentacle apparently suffices as a food-gathering organ. The hydroid is more reduced than that of *Gonionemus* (= *Halcremita*), but not so reduced as the tentacle-less hydroid of *Craspedacusta* (= *Microhydra*). The medusa of *Monobrachium*, however, would be the most highly specialized of all the Olindiidae. It is presumably never released and its minute tentacles, nearly closed ring and radial canals, and closed mouth all point to its reduced nature. If we compare the development of *Gonionemus murbachi* with what I call the adult *Monobrachium*, we see a close resemblance in the 16 tentacles and 4 statocysts of *Monobrachium* to the young of *Gonionemus* (see Russell, 1953, p. 402). Also, the mononidom of *Monobrachium* is the same as that of *Craspedacusta* (and *Microhydra*), *Gonionemus* (and *Halcremita*) and *Olindias* (see Weill, 1934). From the above facts and considerations I have come to the conclusion that *Monobrachium* should be assigned to the Olindiidae, and there is no reason why we should retain the monotypic Monobrachiidae.

I wish to thank Dr. Erik Zeuthen for translating for me pertinent parts of the papers of Leche and Levinsen and Dr. Ralph I. Smith for reading the manuscript.

LITERATURE CITED

- BONNEVIE, K. *Hydroida*. Den Norske Nordhavs—Expedition. Zoologi. I: 1-103, 8 pls, 1 map. 1899.
- BROWNE, E. T. *On British hydroids and medusae*. Proc. Zool. Soc. London 1896: 459-500, 2 pls. 1896.
- GOSSE, P. H. *On a new form of corynoid polypes*. Trans. Linnean Soc. London 22: 113-116, 1 pl. 1857.
- FRASER, C. M. *Monobrachium parasitum and other west coast hydroids*. Trans. Roy. Soc. Canada, (3), 12: 131-138, 2 pls. 1918.
- . *Hydroids of the Pacific Coast of North America*: 207 pp., 44 pls. Univ. Toronto Press, 1937.
- . *Hydroids of the Atlantic coast of North America*: 451 pp., 94 pls. Univ. Toronto Press, 1944.
- . *Distribution and relationship in American Hydroids*: 464 pp. Univ. Toronto Press, 1946.

- HAND, C., and HENDRICKSON, J. R. *A two-tentacled, commensal hydroid from California (Limnomedusae, Proboscoidactyla)*. Biol. Bull. **99**, (1): 74-87, 5 figs., 2 pls. 1950.
- LECHE, W. *Öfversigt Öfver de af Svenska Expeditionerna till Novaja Semlja och Jenissej 1875 Insamlade Hafs-Mollusker*. Kongl. Svenska Vet.-Akad. Handl., N.-F., **16**, (2): 1-86, 2 pls. 1878.
- LEVINSEN, G. M. R. *Meduser, Ctenophorer og Hydronider fra Gronlands Vestkyst, Tilligemed Bemærkninger om Hydroidernes systematik*. Copenhagen Naturh. Foren. Videns. Medd. **1892**, **44**: 143-220. 1893.
- MERESCHKOWSKY, C. *On a new genus of hydroids from the White Sea, with a short description of other new hydroids*. Ann. Mag. Nat. Hist., (4) **20**: 220-229, 2 pls. 1877.
- RUSSELL, F. S. *The medusae of the British Isles*: pp. x + 530, 35 pls. Cambridge Univ. Press, 1953.
- STAFFORD, J. *On the fauna of the Atlantic coast of Canada. Third Report—Gaspé, 1905-1906*. Contr. Can. Biol., 1906-1910: 45-67. 1912.
- WAGNER, J. *Recherches sur l'organisation de Monobrachium parasitum Mértjk*. Arch. Biol. **10**: 273-309, 2 pls. 1890.
- WEILL, R. *Contribution à l'étude des cnidaires et de leurs nematocysts: Vol. II, Valeur taxonomique du cnidome*. Trav. Stat., Zool. Wimereux, **11**, 1934.

PLANT-GROWTH "BRAKE"

There is a "brake" on plant development—perhaps one of Nature's most fundamental controls over surging life. It is a relatively narrow band of light on the edge of the invisible infrared in the solar spectrum. This phenomenon is reported by Dr. R. B. Withrow, head of the Smithsonian Institution's Division of Radiation and Organisms, where the effects of light on the growth and development of plants and animals is being investigated.

Plant life, and through plants all life, is tied intimately to certain solar wave bands. It has long been recognized that the cornerstone of all life on earth is the process of photosynthesis by which plants, through energy provided by sunlight, are able to synthesize carbohydrates from water and carbon dioxide taken from the air. Animals eat these carbohydrates, the basic food. Other animals eat the carbohydrate eaters, and thus the chain extends from the simplest organisms to man.

But without some other process the carbohydrates might be a formless mass. The second process, long studied by the Smithsonian workers, is that which shapes a plant and controls development of stems, leaves, and blossoms. This, Dr. Withrow points out, may be a light effect second in importance only to photosynthesis itself. It requires very little solar energy. Experiments have demonstrated that the control is exercised by red light with a maximum of efficiency at wavelengths around 660 millimicrons—or millionths of millimeters. The Smithsonian findings have been substantiated in several other laboratories. It has been demonstrated, however, that this formative action can be blocked effectively by irradiation with wavelengths in the far red. The greatest effect is at wavelengths between 710 and 730 millimicrons.

The "brake" is not applied immediately. The maximum efficiency of the far red energy occurs a little more than an hour after the plant is exposed to the formative wavelengths, Dr. William Klein, another Smithsonian scientist, has found. The implication is that the action is an interference with the development process by acting on some product the formation of which is initiated by the shorter red wavelengths. The experiments have been carried out with seedlings of beans.

In other experiments by Dr. Withrow and Dr. C. C. Moh, at the Radiation and Organisms laboratory, it was found that damage to plants from X-ray exposure—insofar as this results in breaking the bundle of genes, or units of heredity—can be increased from 30 to 50 percent by previous exposure to about the same wave band of far red light that reverses the formative process. On the other hand, the increase in damage is nullified if the X-ray exposure is followed by exposure to the red wave band.

Breaking of the chromosomes, or strings of genes, is one of the first evidences of damage to living organisms by exposure to ionizing radiation. This breaking is responsible for some of the adverse hereditary effects concerning which there has been a great deal of publicity, because of possible effects of the atomic bomb fall-out.

The Smithsonian experiments were carried out with pollen of *Tradescantia* flowers and root tips of beans where results are relatively easy to determine. Work is now in process to determine how the red and far red spectra exert their effects, and how the results may be applied to altering effects of ionizing radiation in higher animals and men.